INSTRUCTIONS FOR PHILCO® UHF AUTO-LEVEL SWEEP GENERATOR MODEL G8002

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PHILCO MODEL G8002

The need for UHF test equipment has increased greatly with the rapid expansion of UHF broadcasting; however, there has been a conspicuous absence of UHF test equipment at moderate prices. UHF tuners are being used in steadily increasing numbers, with many types requiring repairs or slight touch-ups. In order to properly test the tuner without waste of time, it will be necessary to observe the over-all tuner response curve. This means that the UHF sweep generator is one of the first pieces of UHF test equipment which the well-equipped shop or laboratory should obtain.

The Philco Model G8002 Auto-Level Sweep Generator satisfies the special requirements of UHF testing. This instrument has been engineered to make it outstanding in electrical performance, mechanical ruggedness, and quality of components. The wide-band sweep so necessary at UHF is more than adequate in the G8002. The flatness of sweep so long sought in old VHF generators has been achieved in this UHF model by the use of a new and exclusive automatic leveling circuit, which compensates for output variations. This feature permits comparison of UHF receiver performance regardless of the channels being tested. The exceptional uniformity of output is unusual for any but the most expensive types of UHF laboratory generators.

SPECIFICATIONS

R-F OUTPUT—Maximum of not less than 1 volt peak-to-peak (blanked).

UNIFORMITY OF R-F OUTPUT WITH SWEEP—With the r-f cable properly terminated and with controls set for optimum leveling, there will be less than ±1-db amplitude change over the entire frequency range (470 to 890 mc.).

FREQUENCY COVERAGE—470 to 890 mc. on fundamentals.

NOMINAL OUTPUT IMPEDANCE—75 ohms, unbalanced, at the front-panel connector. The output connector is internally terminated to minimize the standing-wave problem. A 50-ohm connector, located on the r-f sweep unit inside the case, can be used in special applications where 50-ohm lines are necessary.

MONITORING—A built-in monitoring circuit gives a rectified voltage which is proportional to the UHF output. This internal monitor makes it easy to check and adjust the UHF output levels with either a d-c meter or a scope. It also permits the checking and setting of amplitude levels, as well as the measurement of the sweep width on a scope trace when markers are employed.

SWEEP WIDTH—Not less than 25 mc. at Channel 14 and not less than 50 mc. at Channel 83. Continuously variable by use of the sweep-width control.

SCOPE DEFLECTION—A scope connector is provided to supply a 60-cycle sweep voltage to the horizontal terminals of the oscilloscope.

PHASING—The phasing control provides a 140° shift of the phase of the horizontal sweep voltage. This control is used to put the scope sweep in step with the sweep of the generator frequency.

BLANKING—The blanking is adjustable and may be turned off to permit easier phasing adjustment. This control adjusts the time, or phase, of blanking so that the undesired part of the oscillator sweep is blanked out in order that only one trace will appear on the oscilloscope. The blanking effect also gives a base line for reference, since the return trace of the scope appears on the zero line.

R-F POWER CONTROL—This control permits adjustment of the r-f power produced by the r-f sweep oscillator. This control can also be used as an electronic attenuator when a reduction of r-f output is necessary.

R-F LEAKAGE—The leakage has been held to a minimum by the use of special filters plus double shielding of r-f circuits. This makes it possible to use the unit with an external attenuator to produce a low level of r.f. for making low-level signal checks on a sensitive device, such as a UHF television receiver.

TUBES AND CRYSTAL—

1	6AF4	UHF Sweep Oscillator
1	12AT7	Blanking
1	12AV7	Auto-Level Control
1	6AQ5	Electronic Power Control
1	6X4	Full-Wave Rectifier
1	CP-1	UHF Crystal Level Detector and Monitor Detector

TROUBLE-SHOOTING A UHF TELEVISION RECEIVER

A quick check of the r-f and i-f operation of a UHF television receiver may be obtained by simply feeding the UHF sweep into the antennas of the UHF receiver and observing the response at the check points indicated in figure 1.

It will be noted that all the response curves shown are inverted, or "upside-down." This inversion results from the fact that the rectified signal at the mixer grid, the video detector, and the picture tube is normally negative. Since this is the case, it is common practice to make crystal detectors and probes produce an inverted wave in order to be consistent.

The setup shown in figure 1 permits checking the over-all r-f and i-f response curve and sensitivity by connecting the scope to the picture-tube grid. If the result of the check is below normal, then the scope connection is moved back to the video detector. To avoid loading down the circuit, it is desirable to make the connection to the video detector through a resistor of about 6.8K ohms. If the response is not normal at the video-detector output, the scope input is moved to the mixer-grid test point on the VHF tuner. Here again, it is important to connect the scope through a resistor—in this case, one of about

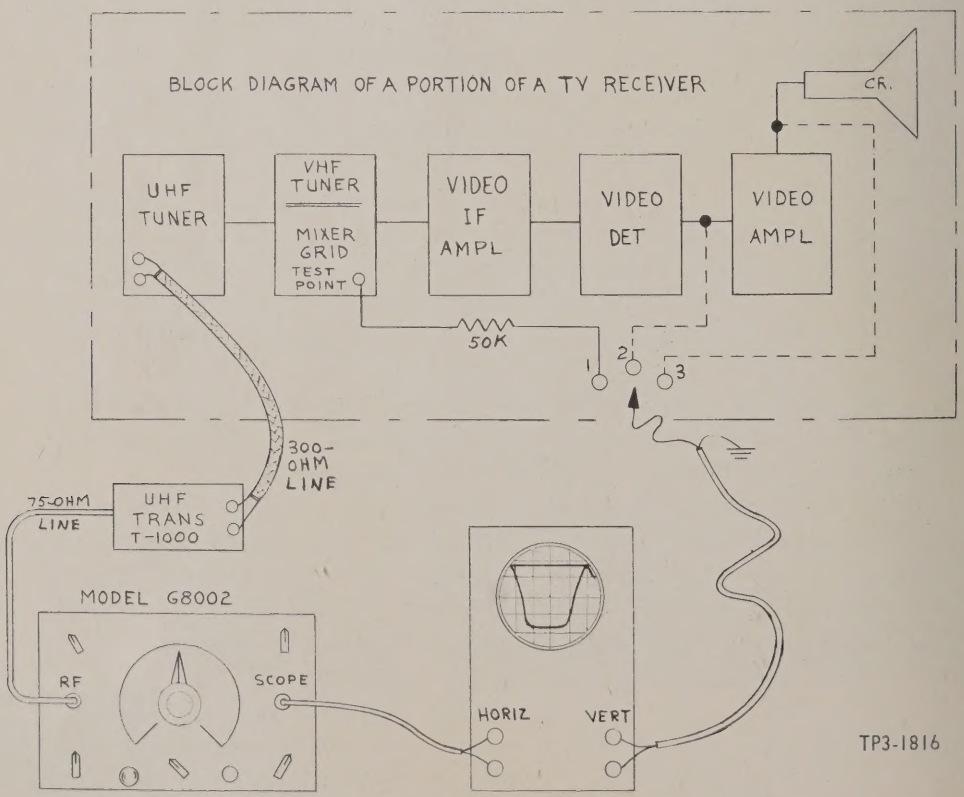


Figure 1. Setup for Trouble-shooting a UHF TV Receiver

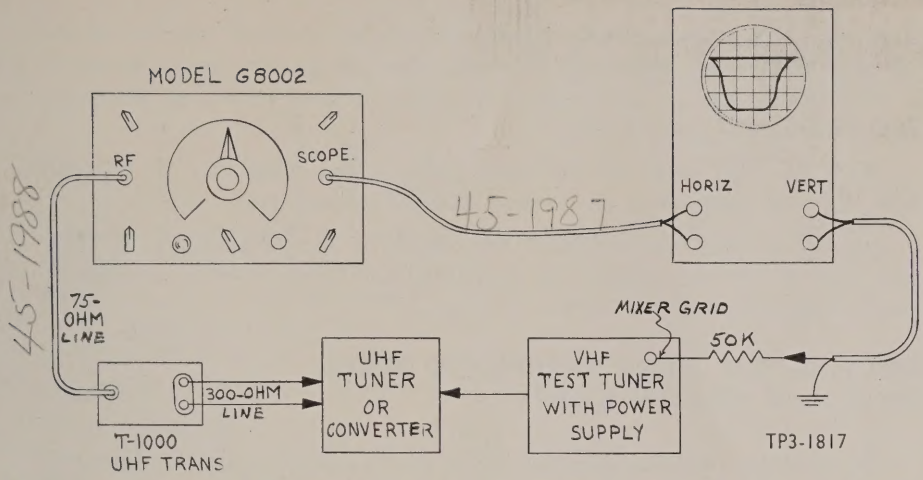


Figure 2. Setup for Checking UHF Tuner and Converter, with VHF Tuner

47K ohms. If a satisfactory response is not obtained at this point, the trouble must be in the VHF or the UHF tuner. If a VHF signal from a station or a VHF generator is available, it can be fed in at the VHF terminals, bypassing the UHF tuner. If this gives satisfactory results, the next step is to check the UHF tuner.

CHECKING UHF TUNERS AND CONVERTERS

Figures 2 and 3 show test hook-ups which can be used to check UHF tuners or converters without the use of a television receiver.

CAUTION:

Although the set-up shown in figure 3 could be used to align a UHF tuner or converter, do not attempt alignment unless the manufacturer gives specific alignment instructions. The basic principles of alignment of UHF tuners are very much the same as those of low-frequency tuners; however, many UHF tuners incorporate special gimmicks and adjustments whose purpose should be understood before adjustment is attempted. There is usually some provision for high- and low-frequency oscillator tracking. There will sometimes be a gimmick, consisting of two twisted wires, which may be used to adjust the oscillator feedback. There may also be small, movable tabs or plates which affect oscillator tank balance and feedback. Such adjustments are sometimes used to eliminate "holes", or dips, in the tuner curve due to absorption effects and falling off of converter-oscillator output. The UHF tuner will usually have some form of tuned r-f preselection circuit between the mixer and the antenna. This circuit should have adjustments such as a high-frequency trimmer and, perhaps, slotted rotor plates, in the case of condenser tuning, which can be "winged" to provide low and mid-band r-f tracking.

The setup of figure 2 shows how the Model G8002 can be used to check the response and relative gain of a UHF tuner or converter. In this case, the output of the UHF unit goes to a VHF tuner, which serves as a test standard. The rectified signal at the mixer grid of the VHF tuner is viewed with an

oscilloscope. The response curve is the result of the combined response of the UHF and VHF tuners. Of course, this setup does not give the true response of the UHF tuner, but it does provide a means of comparison, to determine whether the UHF tuner is faulty.

With the UHF tuner in this setup, crystals and tubes may be changed while observing their effect on the response and relative gain.

A tuner of known good quality may be placed in the setup, and the generator and oscilloscope settings can be marked and standardized as a means of future comparison and evaluation.

CHECKING UHF TUNER BANDWIDTH, CURVE SHAPE, AND RELATIVE GAIN

To check the true characteristics of the tuner, it is necessary that the tuner output signal be detected directly at the tuner output, to eliminate any effect that might be introduced by the i-f tuned circuits. Figure 3 shows how this can be accomplished by using a detector followed by a scope amplifier of good low-frequency response. The scope amplifier is usually needed in this setup because the r-f level does not provide enough detector output to operate oscilloscopes of normal gain.

In order to provide a satisfactory match between the 75-ohm output of the generator and the 300-ohm input of the tuner, a UHF matching transformer Philco Model T1000, was used in the hook-ups of figures 2 and 3.

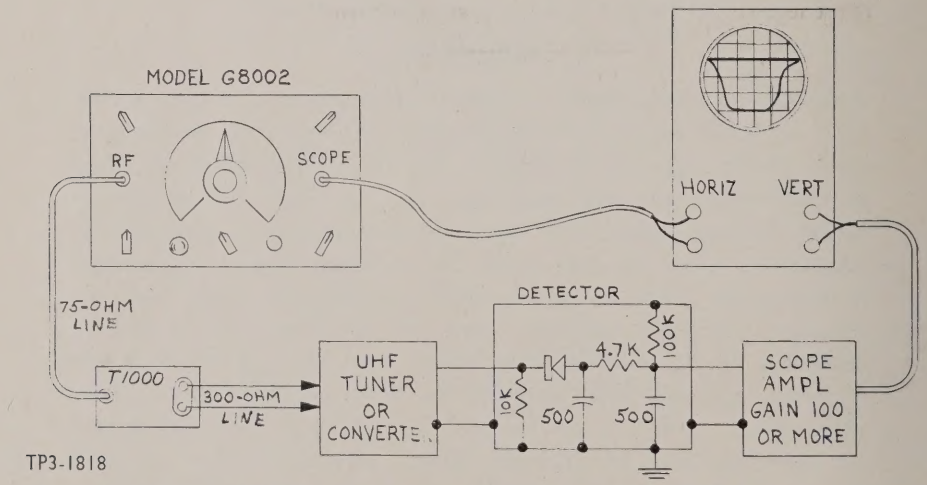


Figure 3. Checking UHF Tuner or Converter by using Philco UHF Auto-Level Sweep Generator, Model G8002, with Detector and Scope Amplifier

UHF DELAY-LINE MEASUREMENTS

Figure 4 shows how the Model G8002 may be used with a delay line to make numerous tests at UHF. The setup shown can be used for measuring standing-wave ratios produced by lines or by the termination device at the end of a line. The curve on the scope shown in figure 4 would be a straight line for a perfect termination of the delay line. If the termination impedance is not 75 ohms (for the 75-ohm delay line used) and is not a pure resistance, there

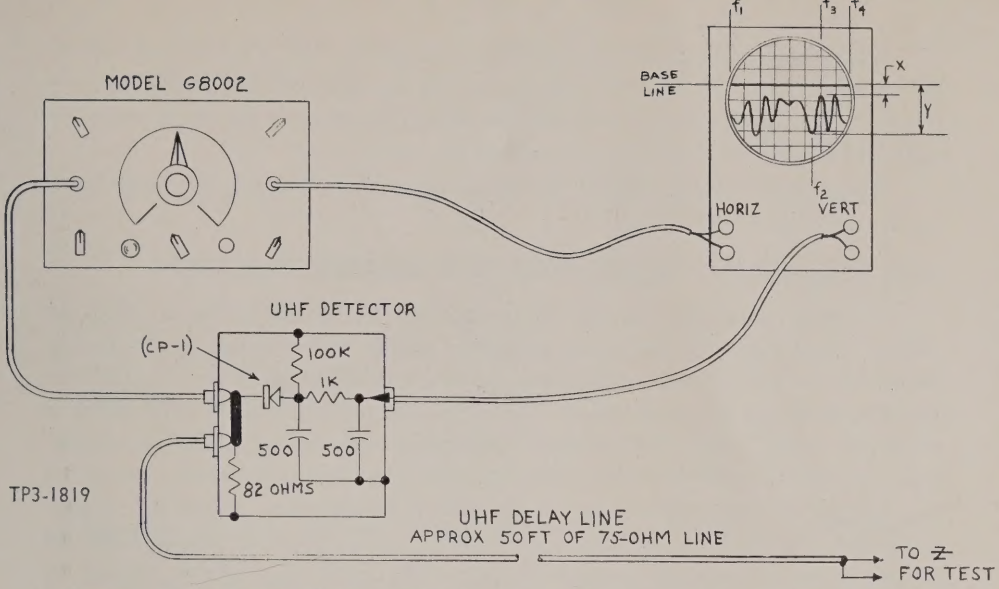


Figure 4. Setup for Making UHF Impedance Measurements and SWR Tests

will be ripples on the curve as shown. As might be expected, the SWR is the ratio:

$$\frac{\text{distance from base line to largest ripple peak}}{\text{distance from base line to the adjacent minimum}} = \frac{Y}{X}$$

It should be remembered that the scope sweep is actually a representation of frequency, so that as the generator sweeps through a band of frequencies, there are points of minimum and maximum and there are points where the termination provides a better match. Checking the SWR by the above method gives a good approximation only if the minimum and maximum points are taken as close together as possible. Obviously, there is some error because the minimum and maximum do not occur at the same frequency. The error can be minimized by using a longer delay line to produce more reflected waves, which will be closer together on the scope trace. There is a limit to the length of line that can be used, however, because of the loss which occurs in the line. This loss introduces some error by making the termination appear better. For more accurate methods of making SWR measurements using the reflection factor, consult an engineering handbook.

The setup shown is also ideally suited for delay-line measurements of the velocity of propagation of a transmission line. To measure the velocity of propagation of a line, cut the line to a known length (preferably 25 to 100 feet) and substitute it for the delay line. Then short-circuit the far end of the line with a piece of copper or other good UHF shorting device, to produce a strong line reflections. Use a marker generator to produce pips on the response curve, and measure the frequency at each of two adjacent peaks. The frequency change between peaks is then the difference, or Δf.

$$\text{The velocity of propagation constant} = \frac{L \times \Delta f}{492}$$

where L is the length of the line in feet
Δf is the frequency difference from peak to peak
or valley to valley, in megacycles

Multiplying the velocity propagation constant by 100 gives the velocity of propagation along the line as a percent of the speed in air. If the propagation constant of a certain line is 0.6, then the actual wavelength on the line will be only 0.6 of the wavelength as calculated for air.

Although a 75-ohm line is shown in figure 4, a line of any impedance can be used.

UHF FREQUENCY CALIBRATION AND MARKER INJECTION

A sweep generator can be spot-calibrated by heterodyning a signal of known frequency with the sweep-generator output and varying the frequency of the known signal until a zero-beat condition is observed in the rectified signal displayed on an oscilloscope. The setup for this method of calibration is shown in figure 5. A VHF generator (using harmonics) or a UHF generator may be used to inject a marker or calibration signal into the cable connecting the generator being calibrated to the television receiver. When the sweep-generator and marker-generator frequencies come together, a zero beat will be observed on the scope. If a signal from a UHF station is available, it may be used instead of the signal from the marker generator. It is accepted practice to calibrate a sweep generator with the sweep width set at minimum.

In all the UHF setups and measurements that have been discussed, it is necessary that special care be taken to make good connections and to insure that all lines are properly terminated. In cases where a 75-ohm line must be matched to a 300-ohm line, a transformer such as the T1000 may be used. If the SWR on 300-ohm lines in a setup is too high, it can be made lower by inserting a 3-db or 6-db pad in each end of the 300-ohm line. However, the insertion of 6 db of attenuation will cut the available signal in half.

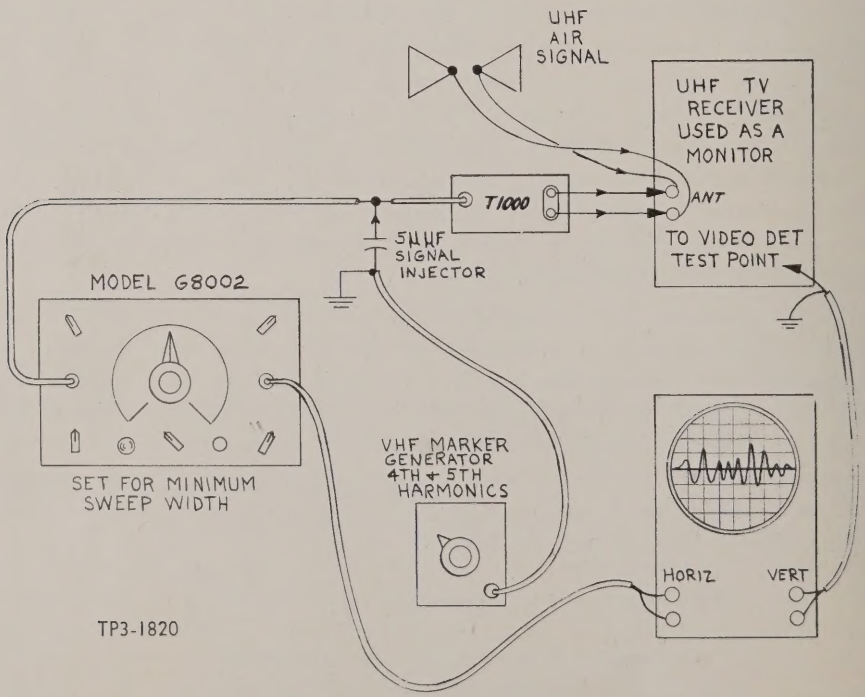


Figure 5. Setup for Frequency Calibration of Philco Auto-Level Sweep Generator, Model G8002

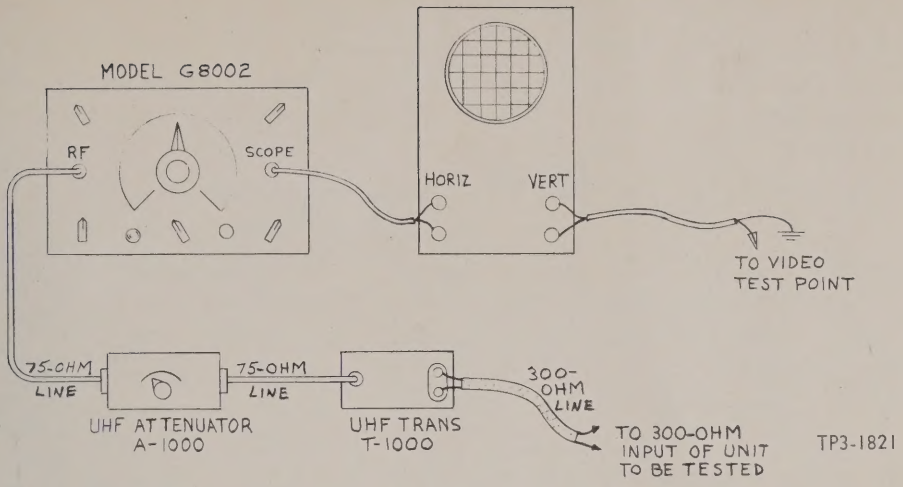


Figure 6. Setup for Using an External Attenuator and Matching Transformer

In the event that a low-level signal is desired from the sweep generator, the Model A1000 UHF attenuator may be inserted in the generator output cable line, as shown in figure 6. The combination of the Model G8002 and the Model A1000 attenuator, with the UHF Model T1000 transformer is a very versatile and complete UHF generator system which will make UHF testing a relatively simple procedure in either the service shop or the laboratory.

CIRCUIT DESCRIPTION

Figure 7 shows the block diagram of the Model G8002 sweep generator, and figure 8 gives the complete schematic. The heart of the r-f section of this generator is a modified form of the new Philco UHF tuner. The early development of this tuner made possible the advanced design and introduction of this generator.

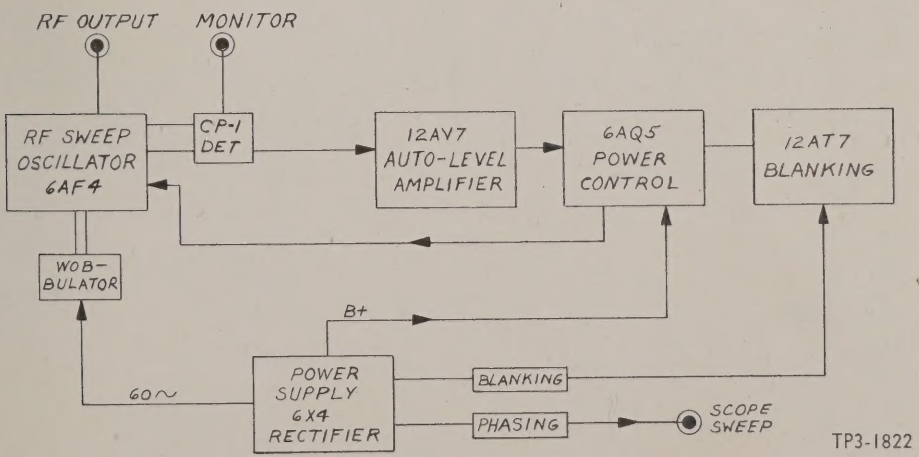


Figure 7. Philco Auto-Level Sweep Generator, Model G8002, Block Diagram

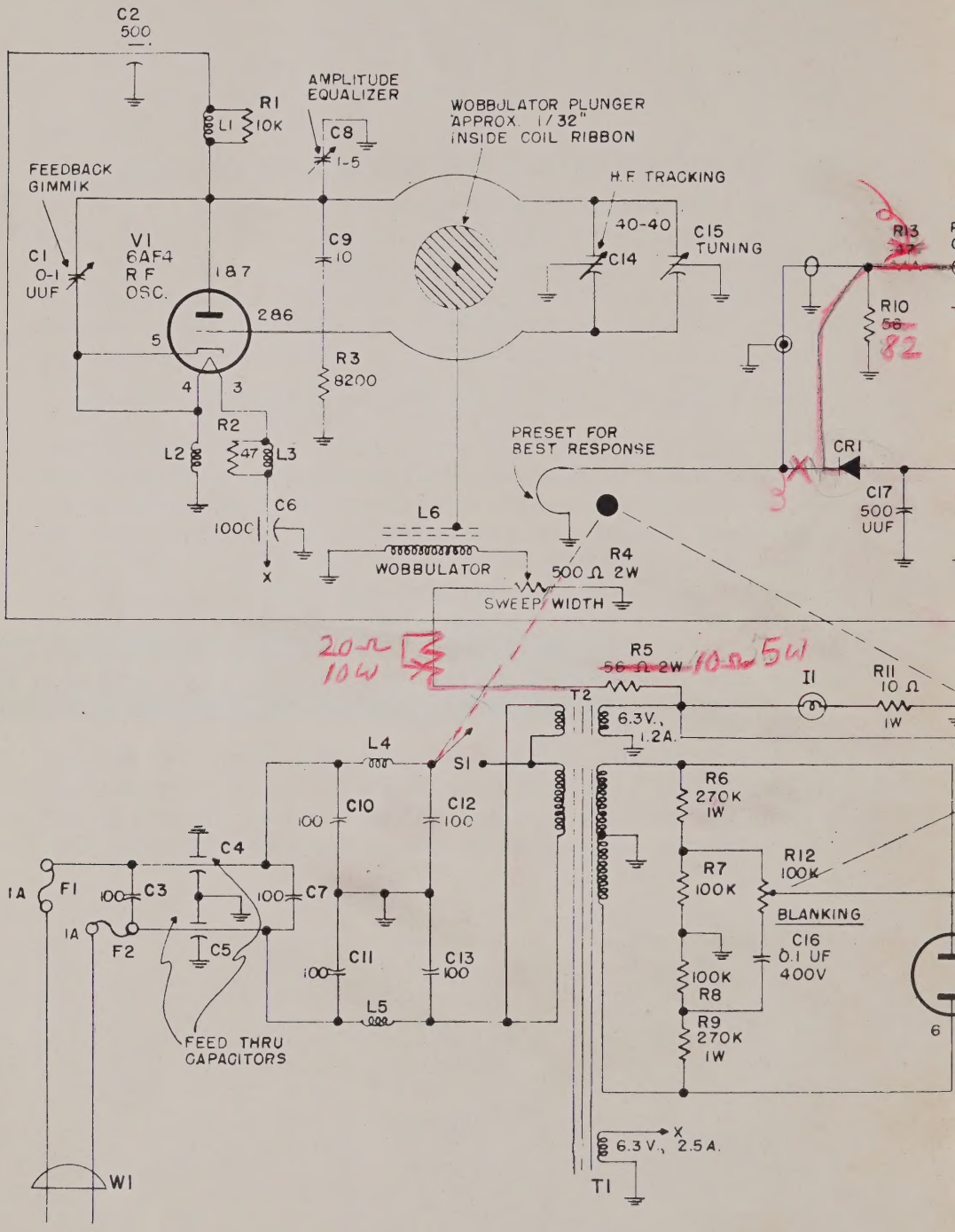
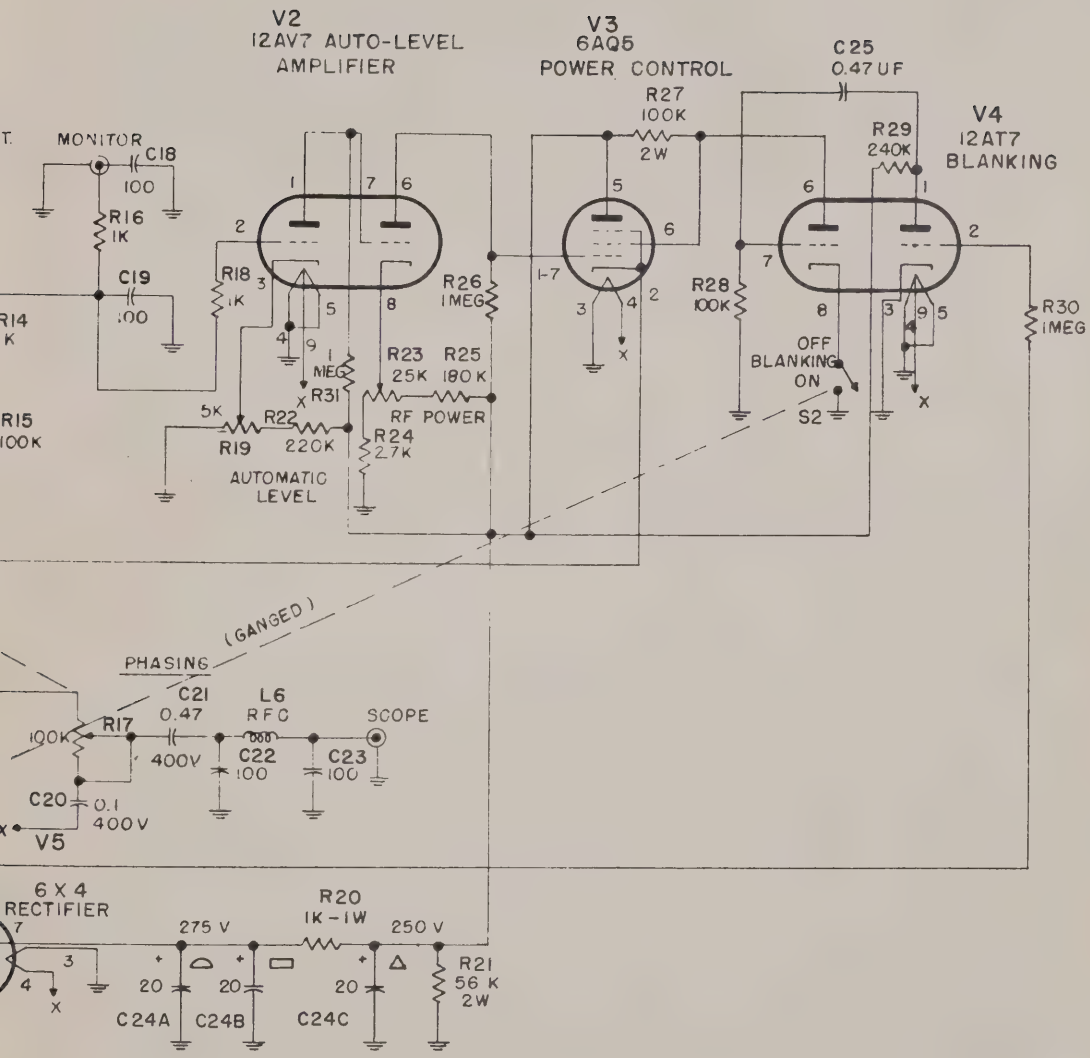


Figure 8. Philco Auto-Level Sweep Gener



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or, Model G8002, Schematic Diagram

The r-f sweep-oscillator circuit utilizes the new UHF triode, type 6AF4. It operates in a simple capacitance-tuned circuit, which gives continuous tuning over the entire UHF television band. The use of a high C:L ratio adds stability to the circuit. Both high- and low-frequency compensation is used to maintain more uniform oscillation over the band.

Sweep action is provided by the use of a mechanical "wobbulator," which gives a convenient 60-cycle, sine-wave sweep. A silver-plated plunger is made to move inside the oscillator "hairpin loop," or coil, in a way that will give optimum linearity of scope deflection with a minimum of amplitude modulation (variation of sweep amplitude as indicated on the scope).

During the sweep time, most sweep-generator designs permit an excessive amount of amplitude variation (about 40%), which affects the shape of the response curve shown on the scope. The new automatic leveling circuit in the Model G8002 serves to flatten the output of the generator and thus to prevent any appreciable amplitude modulation. It not only holds the r-f output constant during the sweep, but it also maintains a practically flat output over the entire UHF band. For maximum leveling, the automatic level control is turned fully clockwise, or in laboratory tests it can be set for precise checks as described under APPLICATIONS.

The automatic leveling works somewhat like an a-g-c circuit. The r-f output of the sweep oscillator is monitored by a UHF crystal detector, type CP-1, and the detector output voltage is amplified by a d-c amplifier, which consists of the two sections of a 12AV7 tube. The amplified d-c voltage from this tube is used to control the current flowing through the 6AQ5 power control tube. The current through the 6AQ5 provides the power for the r-f sweep oscillator. When the oscillator output begins to fall off in amplitude, the rectified voltage from the CP-1 crystal decreases to a less negative value, and the amplified d-c voltage signal on the 6AQ5 grid becomes less negative, thus permitting the sweep-oscillator plate voltage to rise. The over-all effect is to maintain a constant r-f sweep output.

In addition to its action in the automatic leveling circuit, the 6AQ5 tube and the d-c amplifier provide a means for manual control of r-f power to serve as an electronic attenuator. Anyone familiar with the leakage problems which arise in making low-level tests at UHF will appreciate the feature of actual control of generated oscillator power by adjustment of the r-f power control.

A third function of the 6AQ5 is to blank the r-f sweep oscillator during the return sweep cycle on the scope presentation. The 12AT7 blanking tube is connected to the 6AQ5 screen grid so that the 6AQ5 reduces the 6AF4 plate voltage during blanking time. In this way, the 6AF4 r-f sweep oscillator is made to stop oscillating during the return trace of the scope sweep. This action,

of course, permits the vertical-deflection voltage of the scope to drop to zero and, therefore, the return trace is on the zero line. This return trace appears on the screen to form the base line when blanking is employed with correct adjustment of phasing.

The phasing control, which is built into the sweep generator, operates in conjunction with the scope connector to provide the 60-cycle horizontal sweep for the oscilloscope. The phasing control permits adjustment of the scope sweep voltage, to make it have the correct phase, or timing, with respect to the actual sweeping of the r-f oscillator frequency.

The blanking circuit has a blanking control with an on-off switch. A full-wave, type 6X4 rectifier is used in the power supply. The a-c line connection is provided with a very efficient low-pass filter circuit to reduce r-f line leakage to a negligible amount. A UHF filter is also built into the oscilloscope sweep cable to minimize leakage from the scope connector.

OPERATION

This instrument is placed in operation by connecting it to an a-c supply voltage of 110—120 volts, 60 cps. Preliminary adjustments and connections include the following:

1. Set r-f power control fully clockwise.

2. Set automatic level control fully clockwise.

3. Turn blanking control to off position.

4. Set sweep-width control for desired sweep width (maximum sweep width is obtained at full clockwise position of control).

5. Turn frequency dial to frequency at which tests are to be made.

6. When using external horizontal sweep signal, connect scope monitor jack to horizontal-amplifier input terminals of scope, and set scope controls for "Amplifier."

7. Connect r-f output through r-f cable to input of device to be tested. If the device to be tested has an input impedance other than 75 ohms, a suitable matching jig or transformer should be used. Matching techniques and devices are discussed in the section on APPLICATIONS.

8. A rectified or detected component from the output of the device under

test should be fed to the vertical input of the oscilloscope. The frequency dial is adjusted in the conventional way to center the curve on the scope trace. The device under test should be set up and adjusted.

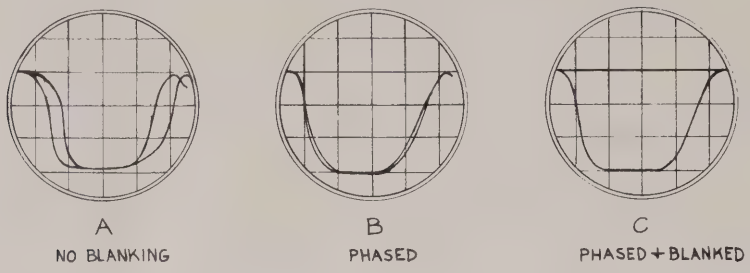

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Figure 9. Adjustment of Phasing Control

9. The oscilloscope is adjusted to give sufficient vertical height of the response curve with the centering controls set as desired.

10. The phasing control is now adjusted to make the two traces on the scope coincide as nearly as possible. This makes the forward and reverse sweep on the scope have the proper phasing in relation to the actual sweep of the generator frequency. If the oscilloscope amplifier is correctly connected internally, this adjustment makes the forward scope trace represent a change of frequency, with the highest frequency on the right side of the scope. Refer to figure 9.

11. The blanking control can be turned on and adjusted only after the phasing control has been set. Blanking should be turned off when the phasing control is adjusted; otherwise, it is difficult to know what the proper phasing point should be. The blanking control is set to provide the most uniform blanking, so that blanking starts at the beginning of the trace and continues to the right edge of the trace. When properly blanked, there will be a response curve for the forward sweep and a straight line (base line) for the return sweep. If excessive hum is picked up in the scope or the device under test, the base line may be curved or distorted.

12. Sweep width should be set to give an easily viewed curve. If the curve appears too narrow for good viewing (occupies only a small part of the scope trace), this means that the sweep width is too great. In this case, the control is adjusted to give the desired curve width by turning counterclockwise. (See SPECIFICATIONS for information on sweep width.) After the sweep width is changed, it may be necessary to readjust the phasing and blanking.

13. The r-f power control can be turned counterclockwise to reduce the power output. This may be necessary in case the device under test is very sensitive to overload. The overload effect would normally show up as a flatten-

ing or squeezing of the response curve being viewed. R-F power should be reduced below the point at which the curve starts to flatten or distort. If the r-f power control is backed off to near minimum, it may be observed that the curve will change shape or disappear because of a stopping of the sweep oscillator. The control should be operated above this point when viewing sweep curves. If a very-low-level r-f signal is needed, an external UHF attenuator, such as the Philco A1000, should be used in the r-f output cable.

AUTOMATIC LEVEL CONTROL

When the automatic level control is in the counterclockwise position, there is no leveling, and the generator operates as a conventional sweep generator. The control provides maximum leveling near the maximum clockwise position. For most servicing tests, it may be set in the clockwise position and left in that position. To obtain good leveling, it is also desirable that the r-f power control be in the clockwise half of its rotation.

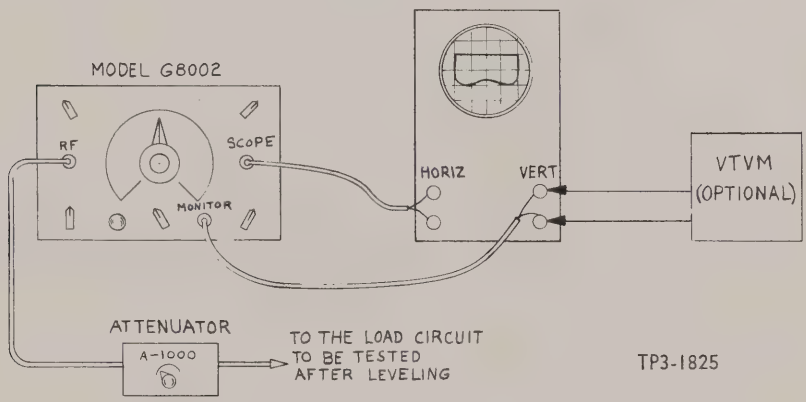

Figure 10. Setup for Adjustment of Leveling Controls

To obtain optimum leveling of the r-f output signal for laboratory tests, or tests requiring high accuracy, make the setup shown in figure 10, and proceed with adjustments as follows:

a. Adjust the sweep controls as they are to be used, and observe the curve or test signal at the UHF frequency to be used. Connect the vertical input of the scope (or another scope or a VTVM) to the monitor jack. The scope should be set up for observing a sweep curve, with its horizontal-deflection voltage coming from the generator scope output jack.

b. Set the blanking at off position, and adjust phasing to make the two lines coincide. Turn blanking on and adjust to get full trace blanking, in order to make the scope trace look like a square wave. The monitor polarity and the usual scope polarity should give a wave form as shown in figure 11(A). The

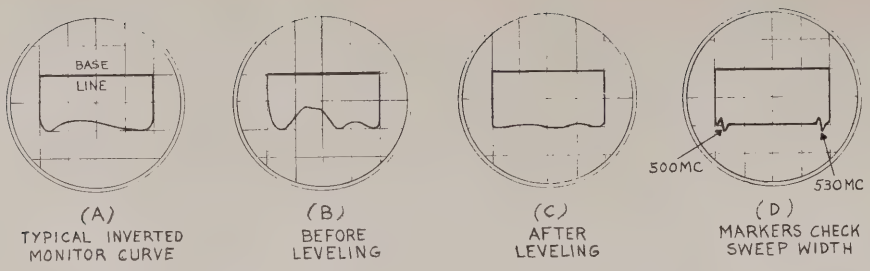

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Figure 11. Sweep Leveling Waveforms at the Monitor Test Jack

base line is at the top, and the response trace, which is negative, is the lower line on the scope waveform.

c. Set the r-f power control near maximum position. Turn the automatic level control for flattest trace. Adjust the r-f power control for best leveling, and again readjust the automatic leveling control. The generator should now be set up for constant output over the sweep range. As the frequency control is turned throughout its entire range, the amplitude change should be only slight. If best leveling is desired for the entire UHF frequency range, turn to the poorest point at one end of the band and readjust r-f power and leveling; then turn to the poorest point at the opposite end of the band and readjust again. An over-all compromise can be found which should give an amplitude leveling that will not change more than 1 db over the entire band if correct cable terminations are used. Figure 11 (B) and (C) shows the sweep output curve before and after leveling. It should be pointed out that it is more difficult to make the curve look flat when the sweep width is maximum.

The setup just described is used to view the "response" or sweep output of the generator alone. For the purpose of measurement, the oscilloscope base line may be considered to represent frequency, with the center frequency of the generator being located about the middle of the trace. This setup is a basis for many types of laboratory tests, and is particularly useful in checking the amount of sweep width. If a UHF marker is fed into the regular r-f output cable (still keeping the proper cable and correct termination of that cable), it should be possible to observe the marker on the scope trace, as shown in figure 11 (D). If the marker-generator frequency is changed, the marker will move along the scope trace. The amount by which the marker-generator frequency (at UHF) is changed to make the marker move from one side of the trace to the other is the sweep width of the generator. Figure 11 (D) shows a curve indicating a sweep width of 30 mc.

REPLACEMENT PARTS LIST

Reference Symbol	DESCRIPTION	Service Part No.
C2	Condenser, 500 uuf.	45-3049
C3	Condenser, 100 uuf.	62-110409001
C4	Condenser, feed-through	45-3048
C5	Condenser, feed-through	45-3048
C7	Condenser, 100 uuf.	62-110409001
C10	Condenser, 100 uuf.	62-110409001
C11	Condenser, 100 uuf.	62-110409001
C12	Condenser, 100 uuf.	62-110409001
C13	Condenser, 100 uuf.	62-110409001
C16	Condenser, .1 uf.	30-4650-47
C17	Condenser, 500 uuf.	45-3049
C18	Condenser, 100 uuf.	62-110409001
C19	Condenser, 100 uuf.	62-110409001
C20	Condenser, .1 uf.	30-4650-47
C21	Condenser, .47 uf.	30-4651-16
C22	Condenser, 100 uuf.	62-110409001
C23	Condenser, 100 uuf.	62-110409001
C24	Condenser, electrolytic, 3-section	45-3041-18
C24A	Condenser, electrolytic	Part of C24
C24B	Condenser, electrolytic	Part of C24
C24C	Condenser, electrolytic	Part of C24
C25	Condenser, .47 uf.	30-4651-16
R2	Resistor, 47 ohms	66-0478340
R4	Potentiometer, 500 ohms, 2 watts	45-3044
R5	Resistor, 56 ohms, 2 watts	66-0565340
R6	Resistor, 270,000 ohms	66-4274340
R7	Resistor, 100,000 ohms	66-4108340
R8	Resistor, 100,000 ohms	66-4108340
R10	Resistor, 56 ohms	66-0568340
R11	Resistor, 10 ohms, 1 watt	66-0104340
R12	Resistor, 100,000 ohms	66-4108340
R13	Resistor, 47 ohms	66-0478340
R14	Resistor, 1000 ohms	66-2108340
R15	Resistor, 100,000 ohms	66-4108340
R16	Resistor, 1000 ohms	66-2108340
R18	Resistor, 1000 ohms	66-2108340
R19	Potentiometer, 5000 ohms, 2 watts	45-3045
R20	Resistor, 1000 ohms, 1 watt	66-2104340

REPLACEMENT PARTS LIST (Cont.)

Reference Symbol	DESCRIPTION	Service Part No.
R21	Resistor, 56,000 ohms, 2 watts	66-3565340
R22	Resistor, 220,000 ohms	66-4228340
R23	Potentiometer, 25,000 ohms, 2 watts	45-3046
R24	Resistor, 2700 ohms	66-2278340
R25	Resistor, 180,000 ohms	66-4188340
R26	Resistor, 1 megohm	66-5108340
R27	Resistor, 100,000 ohms, 2 watts	66-4105340
R28	Resistor, 100,000 ohms	66-4108340
R29	Resistor, 240,000 ohms	66-4248240
R30	Resistor, 1 megohm	66-5108340
L4	R-F choke	32-4556
L5	R-F choke	32-4556
L6	R-F choke	32-4556
I1	Pilot lamp	34-2068
F1	Fuse	AD-2245-7
F2	Fuse	AD-2245-7
CR1	Crystal	~~34-8024~~ 34-8026
W1	Line cord	41-3821
V2	Tube, 12AV7	~~34-2620-2~~
V3	Tube, 6AQ5	~~34-2489-2~~
V4	Tube, 12AT7	~~34-2620-2~~
V5	Tube, 6x4	~~34-2489-8~~
T1	Power transformer	32-8276-1
T2	Filament transformer	45-3042
	MISCELLANEOUS	
	Connector	45-1997
	Connector, ~~UG-290/U~~ UG-447/U	45-1999
	Connector, ~~UG-88/U~~ UG-260/U	45-3047
	Control and switch ass'y.	45-3043
	Front panel	28-9877
	Fuse holder	76-5663
	Handle	28-9641
	Housing assembly	76-~~8486~~ 8835
	Knob, small	54-6085
	Knob, tuning	54-6086
	Pilot-lamp ass'y.	45-3073
	UHF tuner	~~76-7474-8~~ 45-3089
	Wobbulator ass'y.	76-8834

STANDARD WARRANTY

"We warrant Philco Test Equipment to be free from defects in material and workmanship under normal use and service, our obligation under this warranty being limited to making good any part or parts thereof which shall, within ninety (90) days after delivery of such product to the original purchaser, be returned to us through our distributor with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied, and of all other obligations or liabilities on our part, and we neither assume nor authorize any representative or other person to assume for us any other liability in connection with the sale of our products.

"In order to receive the benefit of the above ninety (90) day warranty it is required that the product be registered with Philco Corporation. The Registration Card, postage prepaid, attached to this booklet, must be completed and returned to Philco Corporation.

"We reserve the right to make changes in design or to make additions to or improvements upon this product, without incurring any obligation to modify such previously manufactured product.

"This warranty shall not apply to any product which shall have been repaired or altered in any way so as, in our judgment, to affect its stability or reliability, nor which has been subject to misuse, negligence or accident, nor which has had the serial number altered, effaced or removed. Neither shall this warranty apply to any product which has been connected otherwise than in accordance with the instructions furnished by us."

PHILCO CORPORATION
ACCESSORY DIVISION
PHILADELPHIA 34, PA.

Part No. 78-1604

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